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THEORETICAL AND EXPERIMENTAL STUDY OF GROUNG-EFFECT VEHICLE

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The Ground-Effect Vehicle (WIG) is a type of aircraft that is designed to fly near the surface and uses the Ground Effect to increase aerodynamic quality. In this paper, present an experimental study of the effect of the screen effect on the lift strength of the Ground-Effect Vehicle model. In addition, the simulation results for the WIG in Computational Fluid Dynamics (CFD) are presented/

When the wing flies near the ground, the static pressure below the wing will increase because the air under the wing could not expand freely as it would in free air. Moreover, the induced drag will also be decreased because the wing tip vortices have been weakened. So the lift to drag ratio will be increased remarkably. The effects of ground effect are functions of the height above the boundary. These effects are non-linear and are responsible for many of the complications inherent in the development of WIG craft.

The experiment was conducted in the wind tunnel T-3 at Samara State Aerospace University at low speeds. Firstly, the study of flow around ground surface without the model installation was undertaken, using a plate to simulate the underlying surface. Secondly, the study of aircraft model without the installation of the plate simulating the ground surface was performed. That allowed determination of the model lift in the unrestricted flow. Thirdly, the flow around a model near the ground surface was studied. The angle of attack of the model varies with a step of 1 degree every time. The experiment will be repeated7times using others height, to study the influence of height on the lift of the model. The data from the experiment have been processed and represented in some graphs, in which the consequence of ground effect increases lift can be found. To process the experimental data, a technique is used to recalculate the lift as a function of angle of attack, as well as validate the correctness of the approximation used in it.

A CFD analysis was also conducted to analyse the flow field of the real size aircraft of the case without ground. The analysis is carried out in a finite element analysis software ANSYS, and ANSYS CFX is used as a solver. Owing to the symmetry of the aircraft model, only a half of it was used to establish the geometry, to reduce the computational cost. The CFD environment is set as continuous fluid domain, with material of air of temperature 25℃, and the reference pressure is standard atmospheric pressure. The calculations were conducted for different angle of attack, from 0 degree to 8 degrees with a step of 2 degrees every time. After the analyses, the lift coefficients of the fullscale aircraft can be figured out.

From both wind tunnel experiment and CFD analysis results, the conclusion that ground effect can increase lift is validated. Furthermore, the experimental result and the CFD analysis result are compared. The difference in the results obtained as a result of the calculation and in the experiment, is explained by the difference in Reynolds numbers. Correlation of the obtained data proves that it is possible to use the simulation for the analysis of aerodynamic characteristics instead of carrying out additional tests of the model in the wind tunnel.

References

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